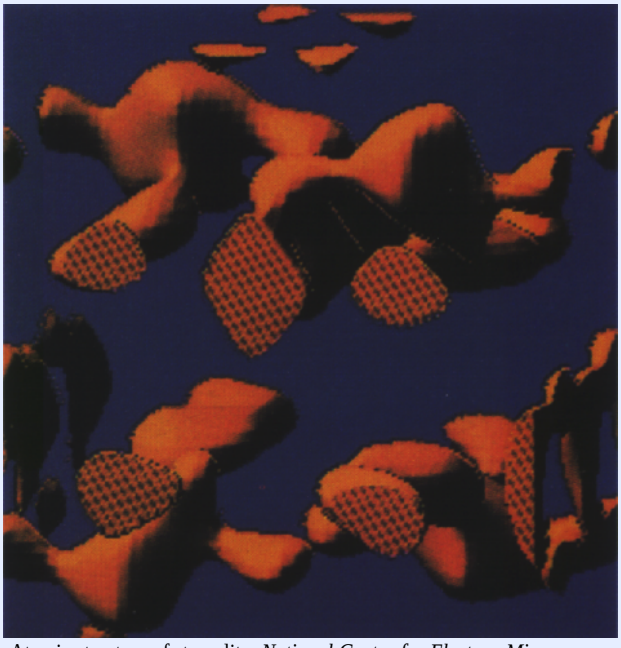
CENTERS FOR ELECTRON BEAM

1.6Å Atomic Resolution Microscope. *National Center fir Electron Microscopy*

In microanalysis, information obtained by combining techniques is often more helpful in problem solving than any single technique.

The U.S. Department of Energy's Office of Basic Energy Sciences operates several micro-analysis research centers. Four are equipped with electron microscopes for analysis of the atomic



Atomic structure of staurolite. *National Center for Electron Microscopy*

structure of solid samples, sample-environment interactions, and local chemical composition. All have a variety of micro-analytical instruments, each dedicated to a different type of structural or chemical analysis

A transmission electron microscope uses an electron beam that interacts with, and is transmitted through, the sample; it is directed and focused by electromagnetic lenses. There are three types of transmission electron microscopy.

A high-resolution or atomic-resolution micra scope is used to obtain an image that exhibits

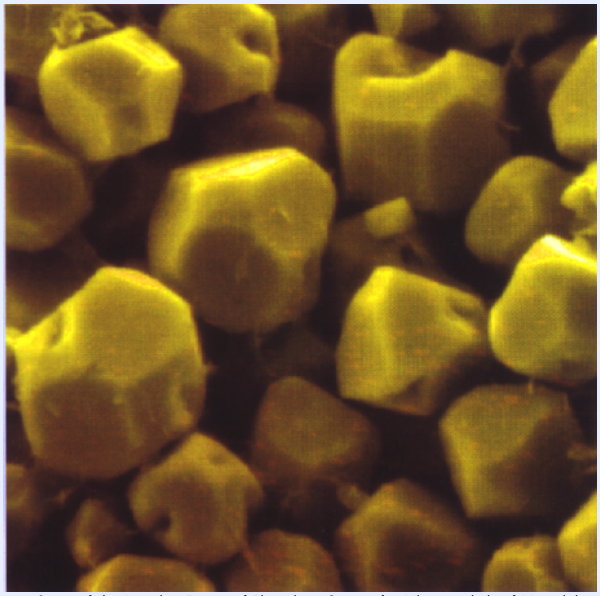
MICROCHARACTERIZATION

contrast due to the different electron scattering capabilities of atoms or their geometrical arrangements within a material under study.

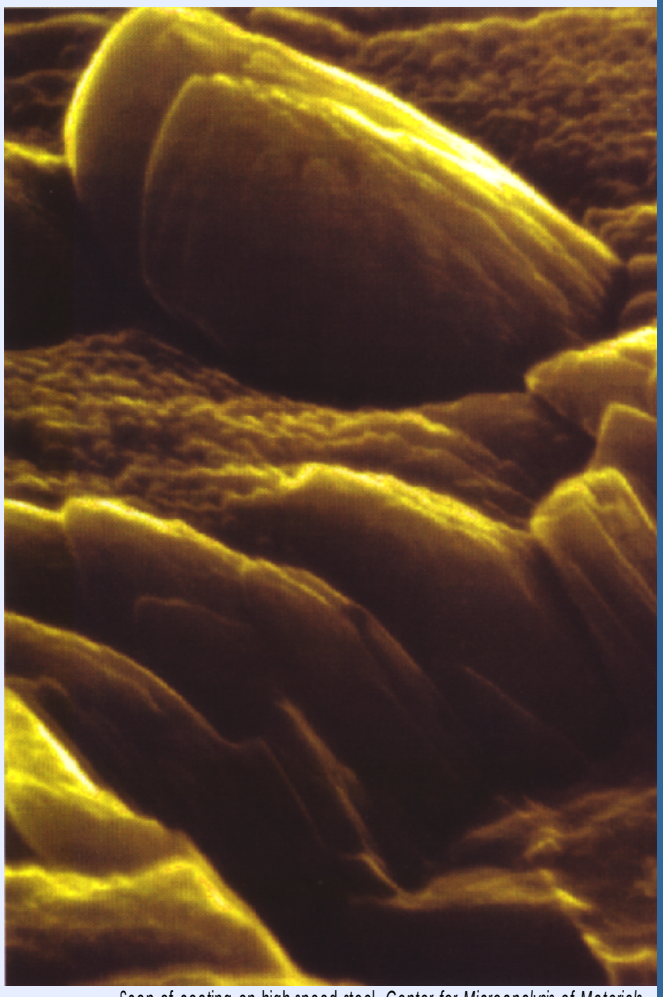
A **high-voltage electron microscope** reveals changes in atomic arrangement in a solid as they occur in real time while reacting with its environment, subjected to a stress, heated, cooled, phase transformed, or irradiated with electrons or ions. This microscope is used to investigate the atomic mechanism of reactions or processes such as corrosion, fracture, film deposition, deformation, sintering, and irradiation effects.

An **analytical electron microscope's** various detectors permit it to perform chemical and crystallographic analysis on the same region of the sample being imaged. Since this region may be a disc that is as small as 2 nanometers, chemical analysis of this type is referred to as elemental microanalysis. Elemental microanalysis is usually carried out by X-ray energy dispersive spectroscopy and/or electron energy loss spectroscopy. Indirect methods of composition analysis based on atomic imaging and microdiffraction are also possible.

Examples of collaborative work at microanalysis research centers include projects at the Shared Research Equipment Program that range from improving the performance of turbine blade materials to improving catalytic converters. Another example brings light to the computer industry – a computer that uses light instead of electric currents was brought closer to reality by research at the Center for Microanalysis of Materials.



Scan of the Leaning Tower of Pisa clay. *Center for Microanalysis of Materials*



Scan of coating on high-speed steel. *Center for Microanalysis of Materials*